

Roll No:

(To be filled in by the candidate)

PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

SEMESTER EXAMINATIONS, DECEMBER - 2015

(SW)BE / BE – PRODUCTION ENGINEERING Semester: 3/4

12P305 FLUID MECHANICS AND MACHINERY

Time: 3 Hours

Maximum Marks: 100

INSTRUCTIONS:

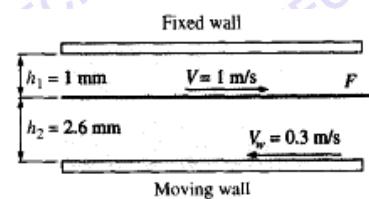
1. Answer **ALL** questions from GROUP – I.
2. Answer any **FOUR** questions from GROUP – II.
3. Answer any **ONE** question from GROUP – III.
4. Ignore the box titled as “Answers for Group III” in the Main Answer Book.
5. **Moody chart may be permitted.**

GROUP - IMarks : $10 \times 3 = 30$

1. What are the characteristics of fluid at rest applied in real time?
2. Capillary rise inside a tube depends on density of fluid in contact. Comment on the statement.
3. Differentiate i) viscous fluid flow from ii) inviscid fluid flow. Provide one example for each.
4. List the limitations of Boundary layer equations.
5. Draw a moving IFE along Y axis and mark the work done on it.
6. With stream lines, visualize fluid flow over an aerofoil kept at an angle of 45° .
7. Analyze and select the boundary conditions applicable to solve fluid flow over a flat plate.
8. Draw a flow chart for representing the procedure in dimensional analysis.
9. Wall shear stress is normally larger in any pipe entrance alone. Justify the statement.
10. Represent pressure and velocity variation across a hydraulic impulse turbine.

GROUP - IIMarks : $4 \times 12.5 = 50$

11. a) A thin $1 \text{ m} \times 0.5 \text{ m}$ flat plate is pulled at 1 m/s horizontally through a 3.6 mm thickness oil layer sandwiched between two plates, one stationary and the other moving at a constant velocity of 0.3 m/s , as shown. The dynamic viscosity of oil is 0.005 Pa.s . Assuming the velocity in each oil layer to vary linearly, (a) plot the velocity profile and find the location where the oil velocity is zero and (b) determine the force that needs to be applied on the plate to maintain this motion. Justify the phenomena causing the velocity profile. (6.5)

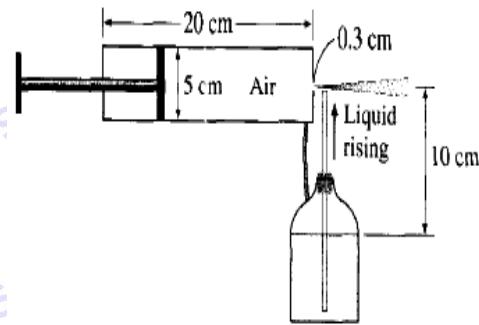


b) Calculate the capillary effect in millimeters in glass tube of 2 mm diameter, when immersed in:

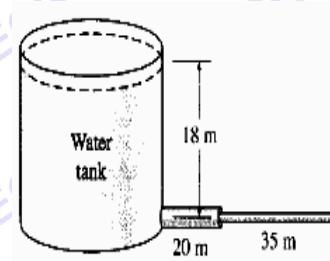
i. Water and ii. Mercury

The temperature of the liquid is 20°C and the values of surface tension of water and mercury at 20°C in contact with air are 0.0736 N/m and 0.51 N/m respectively. The angle of contact for water is zero and mercury is 130° . (6)

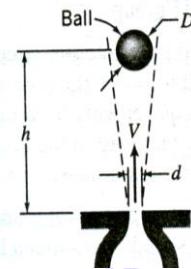
12. A handheld bicycle pump can be used as an atomizer to generate a fine mist of paint by forcing air at a high velocity through a small hole and placing a short tube between the liquid reservoir and the high-speed air jet whose low pressure drives the liquid up through the tube. In such an atomizer, the hole diameter is 0.3 cm, the vertical distance between the liquid level in the tube and the hole is 10 cm, and the bore (diameter) and the stroke of the air pump are 5 cm and 20 cm, respectively. If the atmospheric conditions are 20°C and 95 kPa, determine the minimum speed that the piston must be moved in the cylinder during pumping to initiate the atomizing effect. The liquid reservoir is open to the atmosphere. List the assumptions made and analyze the effect of doubling the atomiser hole size over the paint spray.



13. a) Water at 15°C is drained from a large reservoir using two horizontal plastic pipes connected in series. The first pipe is 20 m long and has a 10 cm diameter, while the second pipe is 15 m long and has a 4 cm diameter. The water level in the reservoir is 18 m above the centerline of the pipe. The pipe entrance is sharp-edged and the contraction between the two pipes is sudden. Neglecting the effect of the kinetic energy correction factor, determine the discharge rate of water from the reservoir. (6.5)



b) The sketch shows an air jet discharging vertically. Experiments show that a ball placed in the jet is suspended in a stable position. The equilibrium height of the ball in the jet is found to depend on D , d , V , ρ , μ and W , where W is the weight of the ball. Dimensional analysis is suggested to correlate experimental data. Find the π – terms that characterize this phenomenon. (6)



14. Write short notes on i) Kaplan wheel and Pelton turbine with their performance characteristics ii) Control of Boundary layer formation and separation.

15. Derive Boundary layer equations along with suitable assumptions. Predict the boundary layer growth over a curved plate and justify the predicted pattern.

GROUP - III

Marks : 1 x 20 = 20

16. Commercially available large wind turbines have blade span diameters as large as 100 m and generate over 3 MW of electric power at peak design conditions. Consider a wind turbine with a 90m blade span subjected to 25 kmph steady winds. If the combined turbine-generator efficiency of the wind turbine is 51 percent, determine (a) the power generated by the turbine and (b) the horizontal force exerted by the wind on the supporting mast of the turbine c) When wind speed increases 3 times, analyze its effect on the turbine performance d) In a wind mill park, when the combined turbine-generator efficiency of the wind turbine increases to 75 %, analyze its effect on the performance. Take the density of air to be 1.125 kg/m^3 , and disregard frictional effects.

17. Derive Navier stokes equation with suitable assumptions. Present the physical significance of each term in this equation while used in flow simulation.

